Clear Roads Research Proposals
2019

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
1	Expanding Brine Recipes and Their Use	$150,000	18 months	The goal of this project is to expand the current brine application rate tables to include brine blends, and update or expand DLA rates to include more scenarios. The expansion needs to include application rates beyond the capability of standard or prior equipment configurations and temperature ranges.	Group 1 Allan Johnson and James Hughes, Wisconsin DOT	5
2	Synthesis: Retention and Recruitment of Highway Maintenance Workers	To be discussed at spring meeting…	12 months	Each State has the same theme of not being able to recruit or hold on to good hands. Rather than study the issue as presented in 2018 (focus on compensation), this project will shift the focus to a synthesis to identify the key factors which explain why employees pursued positions with the state DOT and why are they staying with those agencies over time. This synthesis can be used to show leadership, and ultimately legislatures, that state employment problems can be helped if we make conditions better.	Group 1 2018 CR Proposal from Russell Modrell and Tom Renninger. Resubmitted by Cliff Spoonemore for 2019. Wyoming DOT	8
3	Determining Best Practices for the Management of Fuels for Winter Maintenance Equipment	To be discussed at spring meeting…	12 months	To determine the best methods of sampling and testing fuel for winter use. To determine how to troubleshoot fuel issues in trucks and in storage tanks. To test different methods of maintaining tanks so the fuel we put in them does not degrade.	Group 2 Clay Adams, Kansas DOT	9

Clear Roads Research Proposals
2019

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
4	PSA Library	To be discussed at spring meeting…	12 months	The goal of this project is to host a library of videos created and or labeled from Clear Roads that a state can pick from to post to their social media accounts. They would be short "Winter Maintenance 101" style videos that would be posted on the Winter Preperedness website, which will be live by the summer of 2019 and is already a resource on the Clear Roads website and whose audience is the traveling public.	Group 3 David Gray, NHDOT	11
5	Practical Use of WSI	$125,000	18 months	This research would develop practical guidance and understanding for executives and managers on the use of the WSI tool and how to apply the results to performance measurement, performance reporting, strategic planning, and operational decision making.	Group 3 Jon Fleming, PennDOT	13
6	Synthesis: Inventory and Use of Salt Spreading Systems	To be discussed at spring meeting…	12 months	Each state has various methods and types of salt delivery to the road network. This synthesis would gather information from each state to start an inventory of these different systems and to provide the rational as to why they are used.	Group 3 Jon Fleming, PennDOT	15
7	Benefits of Hiring a Meteorologist	To be discussed at spring meeting…	12 months	The goal is to determine if there is a benefit to hiring an on-staff or consultant meteorologist to provide forecasting more tailored to the needs of a state DOT.	Group 4 Kevin Duby, Jeremy McGuffey, AZDOT, INDOT	16
8	Impacts of Corrosion Inhibited Magnesium Chlorides on Pavement Components such as Cement Pastes, Asphalt Binders and Aggregates	$120,000	18 months	The goal is to test the corrosive or degradation impacts of corrosion inhibited Magnesium Chloride to non-corrosion inhibited Magnesium Chlorides or Sodium Chlorides.	Group 4 Todd Miller, Missouri DOT	18

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2019

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
9	Synthesis: In-Cab Operations Simplification	To be discussed at spring meeting…	12 months	Through what is learned from this project, states can make better decision regarding the way in in-cab environment is configured in order to make it more comfortable for the operator, and thus more ergonomically suited for the long hours that those operators are in the cabs.	Group 4 Larry Gangl, NDDOT	20
10	Environmental Prioritization of Snow Plow Beats	$100,000	12 to 15 months	The goal of the project is to develop a matrix based on established criteria for risk/sensitivity, thus allowing states to make more informed decisions regarding application of chemicals and use of other snow fighting methods.	Group 4 Joe Thompson, NYSDOT	21
11	Synthesis: Private Well Contamination Due to Winter Snow and Ice Operations	$100,000	12 months	To goal of this synthesis is to survey the snow states and collect information regarding their policies and practices with regard to well contamination related to snow and ice activities. What are the commonalities that exist? What are the effective solutions?	Group 5 John DeCastro, Connecticut DOT	23
12	Comparison of Performance of Prewet Road Salt Distributed by Traditional Chain Conveyor Spreader Versus Auger-driven Slurry Spreader	$125,000-$150,000	18 months	The project's goal is to examine the efficiency of prewetting in chain-conveyor versus auger-driven slurry spreaders in side-by-side trials. For an apples-to-apples approach to be used, the same theoretical melting capacity should be used by both vehicles (same ratio of salt to magnesium chloride). Different recipes could be tested (e.g. 8-10 gallons mag chloride/ton of salt), but is important that when the methodologies are assessed side-by-side, the same recipe is utilized by both material spreader types.	Group 5 Mark Goldstein, Patti Caswell, MassDOT; Oregon DOT	24

Clear Roads Research Proposals
2019

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
13	Measuring the Efficiencies of Tow / Wing Plows	$125,000	18 months	The goal is to determine the differences between a standard plow, a plow with wings and a tow plow to denote what, if any, efficiency/gains departments can expect when it purchases tow plows and or trucks with wings. Additionally, return on investment calculations would help inform administrators on future purchases. Finally, a best use scenario for the equipment with the expected efficiencies gained from those instances, i.e. interstate, two-lanes, and the like, would guide agencies on where to best deploy these types of equipment.	Group 5 Douglas McBroom, Montana DOT	26
14	Specifications for Automated Snowplow Route Optimization	$75,000 (probably more like $125,000)	15 to 18 months	The goal of this project is to provide state DOTs with an RFP template that can be used to expedite the procurement of an automated snowplow route optimization program vendor.	Group 5 Scott Lucas, Ohio DOT (2018 project being resubmitted for 2019)	28
15	Mechanical Snowpack / Icepack Breaking Products Comparison: SnowLion vs. Raiko Icebreaker vs. Arctic Shark vs. Belly Plow with "Snow Bits"	$150,000	18 months	The goal of this project is to compare the 1) SnowLion, 2) Raiko Icebreaker, 3) Arctic Shark, and 4) belly plow with "ice bits" side-by-side to see the pros and cons of all 4 products and to see if money can be saved that normally would be spent on salt, but rather would be invested in one of these products. There are multiple models and configurations of each brand and this project would explore a breadth of those models. Cost savings and the reduction of the use of salt products is the overall goal of this project.	Group 5 Ryan Ferrin, Utah DOT	32

2019 Research Proposal Form

Proposer name: Allan Johnson and James Hughes
Organization: Wisconsin DOT (Group 1)

Title of proposed research project: Expanding Brine Recipes and their use

Topic Area (highlight one):
<u>**Methods**</u>   Equipment   Materials   Training   Technology   Safety

1) **Explain the specific problem or issue to address**.
   Clear Roads has researched the effectiveness of brine chemicals and brine application rates for varying weather conditions. Recently in project 15-01 tables were assembled summarizing the data gathered to date, and in project 16-06 videos and reference guides summarize a short list of application rates for Anti-Icing and DLA. Wisconsin DOT feels that data is missing in brine blends and some data needs to be updated in the Direct Liquid Application area. Some of the ranges in the existing tables need to be expanded where NR (not recommended) is identified. (NR may be different for different equipment configurations.)

   Based on a brief informal survey of 14 Clear Roads states, about five states have existing data about existing brine practices that they use. There is evidence of brine blend use by a few states and other scientific data exists, so there is no need for laboratory testing as a part of this project, but a new field study over an entire winter will likely be necessary to have enough data for valid results. Even though this project is mostly about DLA, brine & blends for Anti-Icing and Prewetting should be included so that brine blends may also expand the current boundaries of Anti-icing and Prewetting.

2) **What is the goal of the project?**
   The goal of this project is to expand the current brine application rate tables to include brine blends, and update or expand DLA rates to include more scenarios. The expansion needs to include application rates beyond the capability of standard or prior equipment configurations and temperature ranges.
   Upon completion of the expanded data tables, steps shall be taken to get these values – "AASHTO approved."

3) **Describe the expected products/deliverables of the research.**
   a. Research evidence-based practices from previous winters.
   b. Verify evidence of practices.
   c. Gather new evidence about brine and brine blend use from about 30 routes in about 5 to 7 Clear Roads States (volunteers) noting where achieving the desired level of service.
   d. AASHTO documentation or testing & Prepare the documentation.
   e. Final Face-to-face meeting or webinar presentation.
   f. Coordinate AASHTO approval making sure that deadlines aren't missed.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   a. <u>Existing Data</u>: Survey all Clear Road States to gather data on evidence-based practices (actual use data – not formulas or other research). Wisconsin DOT, Ohio DOT, Iowa DOT, South

Dakota DOT, Minnesota DOT, Pennsylvania DOT and others have existing data about using mostly liquids on a route.

b. <u>Literature Search</u>: Verify through existing research that gathered evidence of practices is supported by previous research & CR projects (nothing older than 5 yrs.).

c. <u>Design and execute a new pilot study</u>: Further verification of data by gathering brine & brine blend use and type information for an entire winter. Formulate a survey to send to 5-7 volunteer states. Each state will commit to use brine and brine blends on at least 3 routes, recording data and submitting it to this project manager in a timely manner. The number of states is not as important here as the number of routes where information is gathered. The number of routes in the new pilot study when added to "existing data" needs to confirm 'statistical significance' of all data that we use to make the conclusions. The data needed should include weather and pavement information about each storm, chemicals used, equipment used and frequency of application. Level of service information may also be useful.

d. <u>Documentation needed for AASHTO review</u>: Results of this research will produce a guidebook or set of tables about the use of brine and some brine mixtures applicable for most winter situations. This task will be to determine what documentation or testing AASHTO would require for support and approval of a few standard brine mixtures and associated application rates. Prepare the documentation for CR pooled fund subcommittee to review prior to submission.

e. Final <u>Face-to-face meeting or webinar presentation</u> where results are shared (after CR subcommittee has agreed with results) and prior to submitting a request to AASHTO. An electronic file of the presentation will be made available to the participants prior to the meeting.

f. Submit documentation for AASHTO approval.

g. Coordinate with AASHTO officials to move this project through the pipeline, keeping to a schedule that will expedite the approval.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Winter Maintenance Supervisors and operators and AASHTO officials are the intended audience. providing them with information needed for them to give it their "stamp of approval". The AASHTO – MaC (Maintenance Committee), will likely be the people that we will need to work with.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.

Using data from Iowa DOT, Wisconsin DOT (through 4 county highway departments) has experimented with brines and brine blends for Direct Liquid Application on a variety of routes and weather situations including interstate highways. For the winter of 2018-19, DLA practices in one county has shown that brine rates can be stretched beyond prior research using higher rates and brine blends when conditions dictate. These new practices have proven to save over 50% of the salt previously used while achieving an unintended higher level of service. For any DOT to be comfortable with a significant best practice change like this, AASHTO concurrence will help dispel liability issues associated by changing the more common practice of using rock salt.

7) **How will you measure the success of this project?**

When Direct Liquid Application is more common practice, being used on more than just test or pilot routes in almost all-weather conditions, this project will show its value. Significant savings in salt use is the easiest way to measure the success of this project.

8) **Estimated funding needed.**
    About $150,000.00

9) **Estimated timeline for completing the research.**
    About 18 Months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**

Most applicable:
   a. CR 15-01 – Material Application Methodologies Guidebook
   b. CR 16-06 – Training Video for the Implementation of Liquid Only Plow Routes
   c. Evaluation and analysis of liquid deicers for winter maintenance – Ohio DOT
   d. Wisconsin Winter Liquid Brine Application – University of Wisconsin, Traffic Ops & Safety research and Training Lab

Other related information:
   a. CR 13-01 – Manual of Environmental Best Practices for Snow and Ice Control
   b. CR 14-10 – Development of a Handbook of BMPs for Road Salt in Winter Maintenance Ops

Future Project (not part of this project): Finally, there is so much data and so many tables to sift through, it seems too much for the snow plow driver to consider prior to treating his route.

To make this data more useable, an 'app' for the cell phone or tablet needs to be developed. For non-MDSS users, the phone 'app' would require the user to input certain specific information to receive a recommended brine or brine blend material with an application rate or a solid material rate if brine is not an appropriate option.

![CLEAR ROADS — research for winter highway maintenance]

2019 Synthesis Request Form

Requestor name: 2018 CR Project from Russell Modrell, Tom Renninger. Resubmitted by Cliff Spoonemore for 2019.
Organization: Wyoming DOT (Group 1)

Title of proposed synthesis project: Retention and Recruitment of Highway Maintenance Workers

Topic area (highlight one):
<u>Methods</u>   Equipment   Materials   **<u>Training</u>**   Technology   Safety

1) **Explain the specific problem or issue to address**:
   Each State has the same theme of not being able to recruit or hold on to good hands. Rather than study the issue as presented in 2018 (focus on compensation), this project will shift the focus to a synthesis to identify the key factors which explain why employees pursued positions with the state DOT and why are they staying with those agencies over time.

   This project will not discount the salary factor, but seek to determine if there are other factors that appeal to the employee. This may vary from one age group to another. If there are factors other than salary that matter significantly, then how to state agencies emphasize those through incentives? How can we focus on our strengths rather than what is outside of our control (mainly salary)?

   This synthesis can be used to show leadership, and ultimately legislatures, that state employment problems can be helped if we make conditions better.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   Literature search on human behavior as it relates to the selection of occupations. Survey agency employees as to why they pursued those positions and why they have stayed. Reach out to agency's Human Resources departments to review employee exit interviews. This project could also lead to the creation of a template for these exit interviews.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
   Information can be used by Human Resource departments for recruiting. Leadership will have objective data to work with, rather than "it seems like" antidotal hearsay. The data from this project can then be distributed to State Legislature Committees in order to influence policy.

4) **Are you aware of any similar or related information on this topic? If so, please list below.** Not at this time.

CLEAR ROADS

research for winter highway maintenance

2019 Research Proposal Form

Proposer name: Clay Adams
Organization: Kansas Department of Transportation

Title of proposed research project: Determining Best Practices for the Management of Fuels for Winter Maintenance Equipment

Topic Area (highlight one):
Methods   **Equipment**   Materials   Training   Technology   Safety

1) **Explain the specific problem or issue to address**. Winter fuel issues can create serious problems during a winter storm event due to frozen pumps and clogged filters at the engine. This can cause plow trucks to be unavailable when they are most needed to clear and treat highways. The problems range from quality of fuel; specifications used; best management practices on sampling, testing, storage, and maintaining clean storage tanks; filters at pumps, Diesel Emission Fluid issues; and Bio-Diesel issues. Basically, all things fuel to keep our trucks running in the winter.

2) **What is the goal of the project?** To determine the best methods of sampling and testing fuel for winter use. To determine how to troubleshoot fuel issues in trucks and in storage tanks. To test different methods of maintaining tanks so the fuel we put in them does not degrade.

3) **Describe the expected products/deliverables of the research.** A manual on how to best manage your winter fuel supply from the point of purchase to the point of combustion in your diesel engine.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
    - Lit Search
    - Survey
    - Follow Up Interviews
    - Manual Development
    - Final Report

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** All State DOT Equipment sections that are involved with winter fuel purchases and or usage.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**. Improved reliability of winter fuel will enhance our snow and ice operations by making our equipment more reliable and reduce down time due to fuel problems at the engine level. For those states whose Dept. of Administration (Division of Equipment) control fuel purchases, it may help.

7) **How will you measure the success of this project?** New information and ideas on how to manage winter fuel.

8) **Estimated funding needed.**

9) **Estimated timeline for completing the research.**

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
Bell Performance: https://www.bellperformance.com/commercial-resources
National Biodiesel Board: https://www.biodiesel.org/using-biodiesel/handling-use/cold-weather-guide
Trucking Info: https://www.truckinginfo.com/156490/everything-in-moderation-including-additives
Government Fleet: https://www.government-fleet.com/157049/how-to-maintain-stored-diesel-fuel

2019 Research Proposal Form

Proposer name: David Gray
Organization: NHDOT (Group 3)

Title of proposed research project: PSA library

Topic Area (highlight one):
Methods   Equipment   Materials   **Training**   Technology   Safety

1) **Explain the specific problem or issue to address**.
   There is a lack of consistent messaging for the public concerning why and how states perform winter maintenance. Part of this issue is that there is difficulty with statewide distribution of information on storms that may be specific to only one part of state.

2) **What is the goal of the project?**
   To host a library of videos created and or labeled from Clear Roads that a state can pick from to post to their social media accounts. They would be short "Winter Maintenance 101" style videos that would be posted on the Winter Preperedness website, which will be live by the summer of 2019 and is already a resource on the Clear Roads website and whose audience is the traveling public.

3) **Describe the expected products/deliverables of the research.**
   Short (30 second to 3 minute) videos that will be posted on Clear Road website that will describe items such as tandem plowing, why snow is left on the road prior to freezing rain, salt effectiveness in cold weather, etc.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   - Literature search and survey of what videos already exists. Of particular interest is the Salt Institute videos. See also collaboration project.
   - Survey of what videos need to be created.
   - Creation of videos and messages for PSA.
   - After Clear Roads approval, provide them to CTC to post on the Winter Preparedness website.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   This is for viewing by the traveling public.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
   These Standardized PSA's can be posted via states' social media accounts during winter to ensure consistent messaging. Neighboring states could post the same message/video before a storm, which could cover commuters that travel across state lines.

7) **How will you measure the success of this project?**
   Public response to posting of videos

8) **Estimated funding needed.**
   Unknown

9) **Estimated timeline for completing the research.**
   - Six (6) months _____
   - Twelve (12) months ___x___
   - Eighteen (18) months _____
   - Other: _____ months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
   Many States have videos and PSA's already created.

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2019 Research Proposal Form

Proposer name: Jon Fleming
Organization: PennDOT (Group 3)

Title of proposed research project: Practical Use of WSI

Topic Area (highlight one):
Methods   Equipment   Materials   Training   Technology   Safety

1) **Explain the specific problem or issue to address**. States have developed Winter or Weather Severity Index (WSI) ratings through RWIS or other meteorological data collection methods. The WSI provides a statistical analysis and severity score relative to other winter events. There are several variations of the WSI currently being used by the states however, there is no clear guidance or means of providing a common understanding for new executives and managers on the practical application of the WSI to operational outcomes and performance.

2) **What is the goal of the project?** This research would develop practical guidance and understanding for executives and managers on the use of the WSI tool and how to apply the results to performance measurement, performance reporting, strategic planning, and operational decision making.

3) **Describe the expected products/deliverables of the research.** Develop written guidance, communication tools, and training materials on the methodologies used to associate WSI scores to desired operational outcomes and decision making.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)** Develop and document the principles of using a WSI to measure resource utilization, operational efficacies, and system recovery during the winter season. Develop a tool, such as an Excel spreadsheet or written guidance on how to graphically display the results of operational evaluations using the WSI tool. Produce a PowerPoint presentation or other materials for training new managers on the use of the WSI tool.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** Transportation Managers and Executives involved in winter maintenance and operations.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**. Measure performance, resource allocation or distribution, make operational adjustments, and identification of areas where additional monitoring or education is needed.

7) **How will you measure the success of this project?** Through surveys to show the increased use and understanding of the WSI tool in transportation network maintenance and operations.

8) **Estimated funding needed.** $125K

9) **Estimated timeline for completing the research.**
    - Six (6) months _____
    - Twelve (12) months _____
    - Eighteen (18) months ___X___
    - Other: _____ months

10) **Are you aware of any similar or related research on this topic? If so, please list below.** CR 16-02 developed a WSI using NWS sites. This provided us with a moderate/severe/average and mild winter WSI or AWSSI rating.

2019 Synthesis Request Form

Requestor name: Jon Fleming
Organization: PennDOT (Group 3)

Title of proposed synthesis project: Inventory and Use of Salt Spreading Systems

Topic area (highlight one):
Methods   **Equipment**   Materials   Training   Technology   Safety

1) **Explain the specific problem or issue to address.** Each state has various methods and types of salt delivery to the road network. This synthesis would gather information from each state to start an inventory of these different systems and to provide the rational as to why they are used.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?** Compile by state the types of salt spreading capabilities and why they use one type of a spreading system over another.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**? Clear Roads members currently have to send e-mails to members asking what kinds of spreading systems they use. This synthesis is proposed to develop an inventory so members can both look at the various methods for salt spreading as well as know which state to reach out to for more information.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
   Research project 12-05 (December 2014) developed an inventory of different spreader equipment with associated pictures. The survey results indicated everyone liked their system and rated them extremely reliable. The study did not answer why one type of spreading system was used over another.

CLEAR ROADS
research for winter highway maintenance

2019 Research Proposal Form

Proposer name: Kevin Duby, Jeremy McGuffey
Organization: AZDOT, INDOT (Group 4)

Title of proposed research project: Benefits of hiring a meteorologist

Topic Area (highlight one):
Methods   Equipment   Materials   Training   **Technology**   Safety

1) **Explain the specific problem or issue to address**.
   There are limited resources available for road weather forecasting. We utilize MDSS and sensor data to make decisions but we have found that MDSS models can be inconsistent and sensor data is only showing current conditions. This has caused poor response and deployment timing during winter storms which can create queues and potentially hazardous road conditions.

2) **What is the goal of the project?**
   The goal is to determine if there is a benefit to hiring an on-staff or consultant meteorologist to provide forecasting more tailored to the needs of a state DOT.

3) **Describe the expected products/deliverables of the research.**
   It is expected that a set of recommendations would show whether or not an on-staff/consultant meteorologist would be able to provide value to DOTs by giving up to date and accurate forecasts.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   Researcher will need to look at current state of forecasting in DOTs and identify opportunity/gaps in data that would allow us to function more efficiently. This information could be compiled through interviews with participating states, brief surveys of the maintenance teams and research of any existing reports/data that the states have already collected in regards to roadway clearance times and response. A set of recommendations based on the previous tasks will provide states with the information needed to make an informed decision.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   The intended audience would be any decision-making authority within the agency. The forecaster would be able to provide data that helps the daily/weekly work planning process

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
   This research would help make DOTs more efficient by providing us quality road forecasting data that allows for better response and recovery during winter operations as well as on-time delivery of construction and maintenance projects.

7) **How will you measure the success of this project?**
   Success can be determined for winter operations by tracking average loss of level of service or by measuring queues.

8) **Estimated funding needed.**

9) **Estimated timeline for completing the research.**
    - Six (6) months _____
    - Twelve (12) months _____
    - Eighteen (18) months _____
    - Other: _____ months

10) **Are you aware of any similar or related research on this topic? If so, please list below.** No

CLEAR ROADS

research for winter highway maintenance

2019 Research Proposal Form

Proposer name: Todd Miller
Organization: Missouri DOT (Group 4)

Title of proposed research project: Impacts of Corrosion Inhibited Magnesium Chlorides on Pavement Components such as Cement Pastes, Asphalt Binders and Aggregates

Topic Area (highlight one):
Methods   Equipment   **<u>Materials</u>**   Training   Technology   Safety

1) **Explain the specific problem or issue to address**.
   Corrosion Inhibited Magnesium Chloride is tested by comparing the corrosion of Sodium Chloride with a metal sample. No comparison of the impacts on the various pavement components is measured. The possible increased impacts to other pavement and bridge components besides the steel has raised some concerns with transportation management officials.

2) **What is the goal of the project?**
   The goal is to test the corrosive or degradation impacts of corrosion inhibited Magnesium Chloride to non-corrosion inhibited Magnesium Chlorides or Sodium Chlorides.

3) **Describe the expected products/deliverables of the research.**
   Corrosion and degradation baseline studies of the impacts of Sodium Chloride compared to the corrosion and degradation of corrosion inhibited and non-corrosion inhibited Magnesium Chloride on various pavement and bridge components such as cement paste, asphalt binder and aggregates.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   Literature research
   Baseline Corrosion and Degradation Studies – Sodium and Magnesium Chlorides
   Comparative Corrosion and Degradation Studies – Corrosion Inhibited Magnesium Chloride
   Research findings in the form of corrosion/degradation rate comparisons

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   The intended audience is transportation maintenance officials who need to weigh the corrosive and degradation impacts of magnesium chloride against the performance the product provides. Also to determine if the corrosion inhibited efforts reduce the impacts to other pavement and bridge components besides the metal.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
   Depending on the outcomes, the corrosion inhibited efforts can assure the public that all components of bridges and pavements are protected to a higher degree with these efforts.

7) **How will you measure the success of this project?**

The delivery of well-defined corrosion/degradation charts that provide conclusive evidence of whether or not corrosion inhibited efforts have a positive impact on the corrosion/degradation of pavement and bridge components other than the steel.

8) **Estimated funding needed.**
   $120,000

9) **Estimated timeline for completing the research.**
   - Six (6) months _____
   - Twelve (12) months _____
   - Eighteen (18) months __X___
   - Other: _____ months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
    Research was performed by Indiana and Purdue Universities on the impacts of various de-icing chemicals on concrete pavements. This did not compare a baseline of non-corrosion inhibited with corrosion inhibited magnesium chlorides which is being proposed with this submittal. This research was performed in 2016.

research for winter highway maintenance

2019 Synthesis Request Form

Requestor name: Larry Gangl
Organization: NDDOT (Group 4)

Title of proposed synthesis project: Synthesis on In-Cab Operations Simplification

Topic area (highlight one):
Methods   **Equipment**   Materials   Training   Technology   Safety

1) **Explain the specific problem or issue to address**. The cabs of snow plow trucks have a lot of equipment in them. They have up to 3 monitors for the sander, AVL, cameras; controls for the front, underbody and wing plows. The have up to 5 joysticks for the tow plows, radio's and many switches.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?** What have other states/cities/counties/countries done to simplify the cab configuration? This synthesis would likely include a survey and follow up interviews to gather information. It is hoped that through these tasks, the research team can collect detailed explanations, drawings, and/or images of their solutions. Examples of information to be collected included…
   a. Where are switches located in relation to the joystick controllers? Sometimes they interfere with each other.
   b. A look at the use of cameras to assist drivers with their visibility.
   c. Some cabs have a lot of noise. Can the cab be better insulated to reduce that noise?
   d. The research team should attempt to determine how, specifically, the reconfigured cabs have helped the operator.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**? Through what is learned from this project, states can make better decision regarding the way in in-cab environment is configured in order to make it more comfortable for the operator, and thus more ergonomically suited for the long hours that those operators are in the cabs.

4.) **Are you aware of any similar or related information on this topic? If so, please list below.**
   • CR 15-02: Identification and Recommendations for Correction of Equipment Factors Causing Fatigue in Snowplow Operators
   • CR 17-03: Aftermarket Cameras in Winter Maintenance Vehicles (In-progress)

CLEAR ROADS
research for winter highway maintenance

2019 Research Proposal Form

Proposer name: Joe Thompson
Organization: NYSDOT (Group 4)

Title of proposed research project: Environmental Prioritization of Snow Plow Beats

Topic Area (highlight one):
Methods   Equipment   Materials   Training   Technology   Safety

1) **Explain the specific problem or issue to address**. The problem is that with the inability to identify environmentally sensitive corridors (beats/routes), the state is unable to assign the proper equipment and apply chemicals at the appropriate rates to avoid further environmental degradation of both surface and ground water with Chloride and Sodium.

2) **What is the goal of the project?** The goal of the project is to develop a matrix based on established criteria for risk/sensitivity, thus allowing states to make more informed decisions regarding application of chemicals and use of other snow fighting methods.

3) **Describe the expected products/deliverables of the research.** Development of a matrix to assign environmental risk/sensitivity to S&I beats and regions. This matrix will provide an ascending prioritized list of beats based on weighted environmental variables attributed to standard GIS layers.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   - Literature Search
   - Survey of states, municipal levels of government, Canadian provinces, and other foreign agencies.
   - Through the previous tasks, identify the factors and criteria and their relative impact to the environmental sensitivity of a S&I beat. How they are weighted to be considered in developing the method/matrix i.e. : Winter severity, 200ft buffer to open water bodies (LF-% of Beat), 0ft buffer to unconfined aquifers (LF-% of Beat), # of Public/Private drinking water wells (EA), Ditch line (LF % of Beat), # of Drop inlets (EA), # of culverts (EA), # of AADT, Tree canopy - shading (LF % of Beat) etc.?
   - Develop a matrix for the prioritization/ranking of S&I beats and a set of instructions / recommendations for applying the matrix to S&I operations.
   - Final Report

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** S&I Program Managers, Resident/District Engineers.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**. This will reinforce good stewardship and program management, identify locations for specialized equipment for snow removal, monitor efforts, and provide a mitigation plan defending against groundwater contamination claims.

7) **How will you measure the success of this project?** Project success will be measured by providing focus to areas of greatest environmental risk resulting in fewer claims against states.

8) **Estimated funding needed.** $100,000

9) **Estimated timeline for completing the research.**
   - Six (6) months _____
   - Twelve (12) months __to 15___
   - Eighteen (18) months _____
   - Other: _____ months

10) **Are you aware of any similar or related research on this topic? If so, please list below.** No.

research for winter highway maintenance

2019 Synthesis Request Form

Requestor name: John DeCastro
Organization: Connecticut DOT (Group 5)

Title of proposed synthesis project: Private Well Contamination due to Winter Snow and Ice Operations

Topic area (highlight one):
Methods   Equipment   Materials   Training   Technology   Safety **Environment**

1) **Explain the specific problem or issue to address**.
   Increases in well contamination due to the use of chlorides in winter maintenance snow and ice operations is a public concern. States have different policies in addressing these concerns. Other agencies often become involved to investigate and resolve. Typically the installation of new wells, the supplying of bottled water, or the mitigation of runoff onto the property are the actions taken. Claims also come into the picture and states can sometimes end up paying these out.

   To goal of this project is to survey the snow states and collect information regarding their policies and practices with regard to well contamination related to snow and ice activities. What are the commonalities that exist? What are the effective solutions?

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   The expected deliverables of this project will be to compile data on well contamination as related to use of chlorides. Get information from states regarding the number of cases. What are the numbers showing? Application rates, chloride type, and well proximity to road information can be helpful in analyzing solutions.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
   The information will be used as a barometer in determining the factors common in well contamination due to chloride usage in snow states.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
   file:///D:/Users/decastrojs/Desktop/Clear%20Roads/Group%205/099-112.pdf

   file:///D:/Users/decastrojs/Desktop/Clear%20Roads/Group%205/Impacts%20of%20road%20salt%20on%20wells%20comtamination.pdf

CLEAR ROADS
research for winter highway maintenance

2019 Research Proposal Form

Proposer name: Mark Goldstein; Patti Caswell
Organization: MassDOT; Oregon DOT (Group 5)

Title of proposed research project: Comparison of performance of prewet road salt distributed by traditional chain conveyor spreader versus auger-driven slurry spreader.

Topic Area (highlight one):
Methods   Equipment   Materials   Training   Technology   Safety

4) **Explain the specific problem or issue to address**.
It has been proven that prewet salt stays concentrated on the roadway for a longer period than dry salt does. Traditional chain-driven conveyor spreaders deliver dry salt to the rear gate of the spreader until salt drops into a hopper/chute that drops it onto the spinner. These spreaders are adaptable to include prewetting technology by the addition of saddle tanks, a pump, hoses and spray nozzles. As salt drops into the hopper/chute, the spray nozzles are aimed at the salt and serve to coat the salt with a mist of magnesium chloride. In addition to helping the prewet salt stick to the roadway longer, the magnesium chloride provides moisture to and thus activates the dry salt to do its freezing point depressing job as soon as it contacts snow and ice.

Slurry spreaders are configured to mix the salt and magnesium chloride in the truck body with an auger which delivers the salt to the rear of the spreader with corkscrew action. Proponents of slurry technology believe that the salt is delivered to the roadway with a greater amount of the pre-wetting solution coating the salt. They point out that the traditional chain-driven conveyor spreader's nozzles operate in a turbulent area on the outside of the spreader body and not all facets of the salt crystal are properly coated with magnesium chloride in this environment.

5) **What is the goal of the project?**
The project's goal is to examine the efficiency of prewetting in chain-conveyor versus auger-driven slurry spreaders in side-by-side trials. For an apples-to-apples approach to be used, the same theoretical melting capacity should be used by both vehicles (same ratio of salt to magnesium chloride). Different recipes could be tested (e.g. 8-10 gallons mag chloride/ton of salt), but is important that when the methodologies are assessed side-by-side, the same recipe is utilized by both material spreader types.

6) **Describe the expected products/deliverables of the research.**
a) A Pro/Con Table comparing both pewetting methods' strengths and weaknesses relative to each other
b) A Written Report on the experimental process, methodology, and outcomes
c) A Video and set of Pictures documenting the side-by-side experiment in a field trial setting
d) Recommendations for usage for each of the 2 products

7) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

a) Synthesis of states (DOT, city, county, etc.) that are currently using either prewetting method.
b) Assessment of the experience of organizations that have utilized both prewetting methods.

c) Design a simple experiment that compares side-by-side performance of both prewetting methods. Establish a performance metric that will be used to assess performance of both prewetting methods: i.e. If GRIP is chosen as the performance metric, use a RWIS friction meter to indicate when the next treatment is necessary. Once grip falls to level x, the next treatment is delivered.
d) Conduct a documented side-by-side field experiment.
e) Create a Written Report complete with a Pro/Con Table, Pictures, Videos, and Recommendations for the better prewetting method.

8) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
All winter maintenance professionals utilizing prewet salt would benefit from this information on the optimal prewetting methods for salt dispensed on roadways. The results of the research and experimentation would inform future purchases of snowfighting equipment and further underscore the need for states that do not currently prewet their salt restructure their winter maintenance program to begin doing so.

9) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
Our organization (like most) is very interested in salt conservation. Optimal application methodologies help conserve salt. With so much environmental/regulatory focus on salt usage and its environmental impacts, it is incumbent upon DOTs to seek ways to use as little salt as possible to establish and maintain safe roadways during snow & ice season.

10) **How will you measure the success of this project?**
If either methodology establishes a clear, replicable performance advantage, that information could be used to restructure winter maintenance programs to embrace the favored technology.

11) **Estimated funding needed.**

$125,000-$150,000

12) **Estimated timeline for completing the research.**

- Six (6) months _____
- Twelve (12) months _____
- Eighteen (18) months __X__
- Other: _____ months

13) **Are you aware of any similar or related research on this topic? If so, please list below.**
Not side-by-side trials.

![CLEAR ROADS logo — research for winter highway maintenance]

2019 Research Proposal Form

Proposer name: Douglas McBroom
Organization: Montana DOT (Group 5)

Title of proposed research project: Measuring the efficiencies of tow/wing plows

Topic Area (highlight one):
Methods   **<u>Equipment</u>**   Materials   Training   Technology   Safety

1) **Explain the specific problem or issue to address**.
   Many DOT's are faced with decreasing budgets for snow and ice removal, but the traveling public is expecting an increased level of service during the winter. Agencies must find ways to provide safe roadways in an ever-decreasing budget. Understanding the tradeoffs between purchase costs and gained efficiencies, reduction in fleet, and personnel decisions is paramount for state agencies to understand prior to making any equipment purchase and deploying the equipment to the most effective location. To date there has been no good determination of the best roads on which to deploy certain equipment, what savings a department can expect, and what the potential return on investments are from purchasing plows with wings and tow plows.

2) **What is the goal of the project?**
   The goal is to determine the differences between a standard plow, a plow with wings and a tow plow to denote what, if any, efficiency/gains departments can expect when it purchases tow plows and or trucks with wings. Additionally, return on investment calculations would help inform administrators on future purchases. Finally, a best use scenario for the equipment with the expected efficiencies gained from those instances, i.e. interstate, two-lanes, and the like, would guide agencies on where to best deploy these types of equipment.

3) **Describe the expected products/deliverables of the research.**
   1. Literature Review
   2. List of efficiencies from trucks with wings and tow plows compared to standard plows—gained through real data sets, simulations etc.
   3. Best use for trucks with wings and tow plows, i.e. interstate, urban, super two's etc.
   4. Using previous research, and information from the efficiency determinations, a calculated return on investment.
   5. A guide for states that gives a menu of efficiencies that can be expected if they deploy the tow plow or plows truck with wings, what the return on investment is, and where to best deploy the equipment.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   The research should conduct a literature review including the studies listed below. The review should include plowing operations and potential efficiencies gained from different equipment used in operations. Additionally, the researcher should investigate different types of operations depending on road geometrics; i.e. multilane, interstate, passing lanes, and two lanes. The researcher should investigate the baseline operations for a standard plow in terms of FTE, return time, material use

etc. on each roadway type. Once the baseline has been established, the exercise is repeated for plows with wings (left, right, both sides) and a tow plow. Results will be compared to the baseline to determine the efficiencies gained, if any, and the best use for each type of equipment. Finally, the researcher will develop a guide for operations, determining best placement of equipment and expected gains in order to better inform maintenance administrators.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Intended audience is equipment managers, purchasing agents, and wintertime maintenance administrators.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
This research would benefit DOT agencies who have funding shortfalls and would help determine the best use for plows with wings and tow plows, as compared to standard plows, the best road geometrics to deploy the equipment, efficiencies gained, and ROI from the purchase.

7) **How will you measure the success of this project?**
Success will be measured by developing a guide to best use of standard plow, plows with wings and tow plows, including proper deployment of the equipment (i.e. two-lane, multilane, etc.) and the expected efficiency gains by deploying the right equipment to the right place.

8) **Estimated funding needed.**
$125,000

9) **Estimated timeline for completing the research.**
   - Six (6) months _____
   - Twelve (12) months _____
   - Eighteen (18) months _X_____
   - Other: _____ months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
Yes

http://aii.transportation.org/Documents/TowPlow/TowPlow-brochure-final.pdf

http://www.dot.state.oh.us/Divisions/Operations/Maintenance/Documents/Tow%20Plow%20Evaluation%20Report.pdf

http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Reports/Final%20Reports/134704_FR.pdf

REQUIRED FEATURES OF THE RFP

TO BE DISCUSSED BY THE SUBCOMMITTEE

Clear Roads Project XX-XX
Draft February 11, 2019

Project Title

Specifications for Automated Snowplow Route Optimization

Project Overview

MnDOT requests responses for a project to develop a Clear Roads Request For Proposals (RFP) template that will be used by state departments of transportation (DOTs) to procure an automated snowplow optimization program vendor.

Some state DOTs use snowplow route optimization programs to optimize their fleet sizing, determine new facility locations, and develop snow and ice routes. Optimization programs can result in cost savings through more efficient and effective use of staff, equipment and materials, and optimal placement of winter maintenance facilities. Additional benefits include improved procurement processes, the availability of additional information for budgeting purposes, use in other maintenance applications and an improved overall asset management.

Automated snowplow route optimization programs are defined as programs that users can change inputs and receive updated results by simply rerunning the program. Inputs can be truck locations, truck material capacities, plowing cycle times, proposed facility locations, number of truck, boundary limits of service area to mention a few.

Automated programs are distinguished from *real-time* programs, which can be updated with new inputs and produce revised routes in real time. Currently, real-time route optimization programs are not readily available and are not included in this project.

Clear Roads is an ongoing pooled fund research project aimed at rigorous testing of winter maintenance materials, equipment and methods for use by highway maintenance crews. Clear Roads will fund and oversee the contract for this project in coordination with MnDOT. For more information, visit www.clearroads.org.

Project Goal

Developing an RFP can be a time-consuming process. The goal of this project is to provide state DOTs with an RFP template that can be used to expedite the procurement of an automated snowplow route optimization program vendor. It is understood that not every DOT and Canadian provinces uses the same RFP format, but the RFP template should include and address the common requirements within the RFPs reviewed. An online survey of state DOTs and Canadian provinces will identify agencies that have developed RFPs for this purpose. The survey will also capture lessons learned and suggestions on what they would do differently. Survey feedback and the results of follow-up interviews will inform the developer of the recommendations for the items, specifications and inputs that should be included in an RFP. These recommendations will be used to develop an RFP template that provides Clear Roads states with a comprehensive, well-researched document that will assist in procuring an automated snowplow route optimization program vendor.

Scope of Work and Deliverables

It is recommended that vendors refer to the following previous Clear Roads project for background information on snowplow route optimization:

> **Clear Roads 14-07: Identifying Best Practices for Snowplow Route Optimization** (January 2017)
> Project description at http://clearroads.org/project/14-07/

This project identified best practices at state agencies for route optimization and facility placement, including the use of Commercial Off-The-Shelf (COTS) software.

Expected Tasks

1. Literature Review. Conduct a literature review of published and in-progress research addressing automated snowplow route optimization applications at the state and province DOT level. Review successful RFP and look for commonality in their construction to build the RFP template. Search for Route Optimization Vendors around the United States and gather points of contact information.

2. Survey of Practice. Conduct an online survey of Clear Roads member states and Canadian provinces to identify the agencies using an automated snowplow route optimization program. A copy of the survey responses will be sent to the vendor and the Clear Roads project subcommittee champion. Also contact Route Optimization Vendors and ask them for survey information and Requests For Information (RFI) documentation on the creation of an RFP for an automated snowplow route optimization program. Provide the draft survey questions to the Clear Roads project subcommittee for approval before distributing the survey. If the Literature Review (Task 1) identified agencies who are likely to have a particularly valuable perspective, use additional direct outreach as needed to request their participation in the survey. Also direct additional attention toward any of the vendors that state they can provide a high level of automation in their route optimization software.

3. Interviews. Conduct in-depth interviews with 4 to 6 survey respondents that maintain route optimization programs, focusing on agencies and vendors with the highest level of automation in their programs. Before beginning the interviews, provide the Clear Roads project subcommittee with a list of proposed agencies and vendors for their approval. Include an overview and rationale for the agencies' selection.

   Interviews may be conducted by phone or videoconference, and should address the following topics:
   - Classification of the agency's or vendor's level of route automation, (fully automated or partially automated).
   - Description of the program's operation and the tasks managed through it that verify the programs level of automation.
   - Additional uses for the program, such as street sweeping, storm sewer cleaning, mowing, herbicide spraying, lane line striping and other route-specific tasks.
   - Specifications and inputs identified in the agency's RFP.
   - Lessons learned.
   - What, if anything, the agency would change if they were going to send out a new RFP.
   - Copies of the agency's RFP and any other relevant documentation, such as contract documents outlining required tasks and deliverables.
   - Copies of vendor's RFI for automated route optimization and any RFPs they are willing to share with comments for improvement.
   - A representative of the Clear Roads project subcommittee must be present during the phone or videoconference.

   A narrative summary of each interview should be included in the final report (Task 6).

4. Recommendations. Develop a set of recommendations for the items and specifications that should be included in an RFP issued by a state DOT seeking an automated snowplow route optimization program vendor. These recommendations should be informed by the results of the

three previous tasks and may include different tiers or optional items reflecting the varying levels of services and support that an agency might require.

Provide these recommendations to the Clear Roads project subcommittee for approval before proceeding to Task 5.

5. <u>RFP template and requirements document</u>. Create an RFP template that is validated by survey and interview results, the recommendations developed in Task 4, and the sample RFPs provided by interviewees. Use the same resources to prepare a requirements document to be included with the RFP template that includes a list of variables that can serve as inputs for the route optimization program itself (lane miles, locations of facilities, number and capacity of trucks, etc.).

6. <u>Final Report.</u> Prepare a final report that incorporates the results of Tasks 1 through 5. The primary purpose of the report is to provide state DOTs with the information needed to acquire an automated snowplow route optimization program vendor. Prepare and present a final closeout webinar.

Expected Deliverables

1. A kick-off teleconference at the start of the project to review project tasks and goals and discuss the plans for all Tasks.
2. Check-in teleconferences with Clear Roads to review deliverables of Tasks 1, 2, 3, 4 and 5.
3. Literature review of vendors, state and provincial-level research. (Task 1).
4. Survey of vendors, state and provincial practices. (Task 1)
5. Interviews with agencies currently using an automated snowplow route optimization program. (Task 2)
6. Interview of venders who create automated snowplow route optimization programs.
7. Recommendations for content to be included in an RFP. (Task 3)
8. RFP template and requirements document. (Task 4)
9. Final Report that includes an executive summary of the study format and findings and the results of each task.
10. Factsheet that summarizes the project and poster that can be presented at the Transportation Research Board annual meeting.
11. A PowerPoint™ to support presentations at conferences or national and regional meetings by Clear Roads members regarding findings and recommendations resulting from the project.
12. Face-to-face meeting or webinar presentation to present the final deliverables. The vendor will provide the draft versions at least two weeks in advance of the meeting or webinar. The vendor should also assume there will be some additional time after the presentation required to gather and incorporate feedback for final acceptance.
13. Quarterly Reports that provide written reports of progress to the Clear Roads TAC at the end of each quarter of the year (March 31, June 30, September 30, December 31) for the duration of the contract.

Desired Skills/Qualifications (To be reviewed by Greg)
While not required on a pass/fail basis, demonstration of the following desired skills will be taken into consideration when rating responders' qualifications and experience.

1. ***A degree in civil engineering, computer science or related field of study to understand the principles and be able to analyze the available information on route optimization programs.***
2. ***Experience with developing and analyzing surveys and conducting practitioner interviews.***

3. *Demonstrated ability to conduct case studies on transportation engineering and practice.*
4. *Ability to synthesize information and produce working documents or guidelines for others to follow.*
5. *The research team should include at least one person with both theoretical and practical experience with winter highway maintenance operations, including the use of computer programs.*

It is estimated that the cost of this contract should not exceed $75,000.

Proposal Evaluation (To be completed by Greg)
Representatives of MnDOT will evaluate all proposals received by the deadline. In some instances, an interview may be part of the evaluation process. MnDOT reserves the right, based on scores of the proposals, to create a short-list of responders to interview. A 100-point scale will be used to create the final evaluation recommendation. The factors and weighting on which proposals will be judged are broken down in the following table:

Rating Factor	Weighting Percentage
Project Understanding	20%
Work Plan / Detailed Deliverables	25%
Background and Experience of Company	5%
Background and Experience of Personnel	20%
Cost Detail	30%

Proposals will be evaluated on a "best value" basis with 70% qualifications and 30% cost considerations. The review committee will not open the cost proposals until after the qualifications points are awarded.

2019 Research Proposal Form

Proposer name: Ryan Ferrin
Organization: Utah Department of Transportation (UDOT)

Title of proposed research project: Mechanical Snowpack / Icepack Breaking Products Comparison: SnowLion vs. Raiko Icebreaker vs. Arctic Shark vs. Belly Plow with "Snow Bits"

Topic Area (highlight one):
Methods   **Equipment**   Materials   Training   Technology   Safety

1) **Explain the specific problem or issue to address**.
   With the Environmental Protection Agency (EPA) becoming more and more stringent with the regulations allowing the use of traditional salt products on the roadways to combat snow and ice, DOTs across the country are looking for alternative methods to break through stubborn snowpack and icepack that do not involve the use of rock salt. The traditional method of breaking up snowpack and icepack consists of spreading rock salt across the roadway surface, waiting for salt activation, and then chipping away at the snowpack or icepack with a plow, grader, or loader until bare pavement is achieved. This is a time consuming and costly process for DOTs to endure, not to mention the environmental impacts of using a corrosive chemical like salt on the roadways. The corrosion of roadway assets, vehicles, and structures containing metal is also a byproduct of salt usage that costs states an immeasurable amount of money and manpower each year.

   There are 3 similar products currently on the market that have branded themselves as mechanical snowpack and icepack breakers that do not require the use of salt and thus may prove useful alternatives for this process: 1) SnowLion, 2) Raiko Icebreaker (made by Team Eagle), and 3) Arctic Shark (made by Ultramech). All 3 brands of units are heavy metal drums/rotaries with spikes spread across them similar to lawn aerators. These products attach to a front end loader and are run over snowpack or icepack to quickly break it up for removal by the snow plows that follow.

   A 4th method of snow and icepack breaking (with reduced or no salt usage) is the process of having a belly plow equipped with "ice bits" scrape away at the pack. We would like to compare all 4 methods to each other in a side-by-side experiment.

2) **What is the goal of the project?**
   The goal of this project is to compare the 1) SnowLion, 2) Raiko Icebreaker, 3) Arctic Shark, and 4) belly plow with "ice bits" side-by-side to see the pros and cons of all 4 products and to see if money can be saved that normally would be spent on salt, but rather would be invested in one of these products. There are multiple models and configurations of each brand and this project would explore a breadth of those models. Cost savings and the reduction of the use of salt products is the overall goal of this project.

3) **Describe the expected products/deliverables of the research.**
   a) A Pro/Con Table comparing all 4 products' strengths and weaknesses relative to each other
   b) A Written Report on the experimental process, methodology, and outcomes
   c) A Video and set of Pictures documenting the side-by-side experiment in a field trial setting
   d) Recommendations for usage for each of the 4 products

e) Design a Test Protocol that takes into account such factors as, but not limited to: Pavement type, air temperature, pavement temperature, presence of salt residue, thickness of icepack, thickness of snowpack, travel speed of device when used, etc. so that this experiment can be replicated in the future at different locations with the same working conditions. This Test Protocol should establish a repeatable testing model that icebreakers will be tested against in the future.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

a) Synthesis of states (DOT, city, county, etc.) that are currently using or have used the 1) SnowLion, 2) Raiko Icebreaker, 3) Arctic Shark, and 4) belly plow with "ice bits" products in the past.
b) Interviews and surveys of those states to gain an understanding of their experience with the 4 products and if cost savings regarding reduced salt usage was realized.
c) Synthesis of the environmental regulations regarding salt usage for wintertime operations set forth by the EPA according to geographical location.
d) Conduct a filmed (video and still pictures) side-by-side field experiment showcasing the 1) SnowLion, 2) Raiko Icebreaker, 3) Arctic Shark, and 4) belly plow with "ice bits" at work on the same stretch of snowpack or icepack.
e) Create a Written Report complete with a Pro/Con Table, Pictures, Videos, and Recommendations for the use of each of the 4 products.
f) Design a Test Protocol that can be used in the future to compare icebreaking products at different locations, but under the same working conditions.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**

The material resulting from this research would be shared with maintenance managers of all DOTs and would be made available to any public and private entity interested in partnering with the highway maintenance professionals.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.

The information garnered from this project may impact how DOT's and municipalities conduct their operations when it comes to breaking up snowpack and icepack. This project may lead to more states utilizing these kinds of mechanical snowpack and icepack breakers rather than relying solely on salt products and the "chipping method" alone. The widespread use of these mechanical icebreaking products across the country may become the norm in the near future and thus bring the country more in line with EPA regulations and requirements regarding salt usage in wintertime operations.

7) **How will you measure the success of this project?**

The success of this project will be measured by whether or not a fair and impartial experiment can be conducted and with valid test results comparing the 4 products side-by-side. The Test Protocol that is developed will be successful if the experiment can be replicated with an acceptable level of repeatability in regards to testing mechanical icepack breakers in the future. Success will also be measured by a reduction in salt usage across the country if these kinds of mechanical icebreaking products become the go-to method that state DOTs begin using as rock salt use is slowly phased out.

8) **Estimated funding needed.** $150,000?

9) **Estimated timeline for completing the research.** 18 months
10) **Are you aware of any similar or related research on this topic? If so, please list below.**

I am not aware of any side-by-side experiments that have been conducted comparing the 1) SnowLion, 2) Raiko Icebreaker, 3) Arctic Shark, and 4) belly plow with "ice bits". There are many YouTube videos of all 4 of the products at work on the web, but none that I can find that compare the 4 directly side-by-side. In Utah we are going to conduct a filmed side-by-side experiment with the SnowLion and the Raiko Icebreaker when we open up Mirror Lake Highway (UT-150) in May 2019.